DOCUMENT RESUME

ED 139 602 SE 021 335

AUTHOR Douglas, Ian; And Others
TITLE Three Statements on Environmental Education. C.A.T. Education Monograph No. 12.
INSTITUTION Association for Environmental Studies, New South Wales (Australia).
PUB DATE Aug 75
NOTE 51p.

EDRS PRICE MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS *Conservation (Environment); *Curriculum Development; Ecology; *Environmental Education; *Instruction; *Interdisciplinary Approach; Pollution; *Science Education; Social Problems; Teacher Education
IDENTIFIERS *Australia

ABSTRACT

Presented are three articles on environmental education representing the views of four authorities from the fields of geography, sociology, biology, and conservation. The first article stresses the need for successful management of the global environment and global environmental education. The second article details the social effects of environmental decay and discusses the role education must play in the transformation of society and its values. The final article suggests conservation topics which should be included in science courses at the secondary level and details methods for their integration as part of an overall conservation approach. Also discussed in the final article are: (1) the integration of environmental concepts into the curriculum; (2) field studies; (3) class evaluation; (4) the relationship of conservation education to environmental studies; (5) audio-visual aids; and (6) teacher education. (BT)

****
* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. Nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *
****

ED139602

C.A.T. EDUCATION MONOGRAPH

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

SE 021 335

2

MACQUARIE UNIVERSITY
CENTRE FOR ADVANCEMENT OF TEACHING

JUN 30 1976

No. 12

THREE STATEMENTS ON ENVIRONMENTAL EDUCATION

by Ian Douglas, Stephen Hill
Donald McMichael & Alan Strom

THREE STATEMENTS ON ENVIRONMENTAL EDUCATION

CONTENTS

	Page
Introduction	1
The Association for Environmental Studies (N.S.W.)	2
Understanding and Managing the Environment	4
"The Ecology Crisis and Society": Can Education help us to Survive?	17
Teaching Science for an Understanding of our Total Environment and the Need for Conservation	29

A JOINT PUBLICATION BY THE
CENTRE FOR ADVANCEMENT OF TEACHING
MACQUARIE UNIVERSITY
AND THE
ASSOCIATION FOR ENVIRONMENTAL STUDIES (NSW)
August 1975

INTRODUCTION

The first two of these articles are based on talks given by Ian Douglas and Stephen Hill at the Inaugural Meeting of the Association for Environmental Studies (New South Wales) held at Macquarie University on 8th and 9th September, 1972. The third article by Don McMichael and Alan Strom was commissioned by the present editor as a chapter of a textbook for teacher trainees which, for various reasons, was not completed.

The three articles are of special interest in that they represent the views of four recognised authorities from the fields of geography, sociology, biology and conservation.

As the problems of education are, in the mid-70's, becoming a real issue in curriculum development in Australian school systems, the Centre for Advancement of Teaching takes particular pleasure in co-operating with the Association for Environmental Studies (New South Wales) in making available to environmentalists, conservationists and educators this previously unpublished material.

G.R. Meyer,
Director,
Centre for Advancement of Teaching;
President,
Association for Environmental
Studies (N.S.W.).

THE ASSOCIATION FOR ENVIRONMENTAL EDUCATION (N.S.W.)

The aims of the Association are -

- to encourage the establishment of environmental studies centres.
- to co-ordinate the activities of bodies engaged in environmental education and training.
- to provide programs in environmental education and develop environmental education resources.
- to stimulate an awareness of environmental problems.
- to advance education on the importance of the environment and of the status of man in the environment.

MEMBER ACTIVITIES

Activities include visits to field studies centres, youth hostels, national parks, museums and schools. Residential field courses, seminars and workshops are also arranged from time to time on aspects of environmental education.

Members are invited to participate in -

- inspections of environmental studies centres and proposed sites for such centres.
- planning of courses in environmental studies for such centres.
- critical viewing of environmental films.
- symposia on problems of teaching environmental concepts within present school curricula.
- designing new curricula or courses for environmental education.
- study courses in methods of teaching about the environment.

Members are also invited to participate in the work of our Study Groups engaged in projects such as -

. preparation of environmental teaching materials.

. detailed analysis of a suburban area to identify features relevant to environmental studies.

. preparation of progams for training persons as teachers in environmental education.

The address of the Association is -

The Hononary Secretary,
Association for Environmental Studies (N.S.W.),
Post Office Box 279,
Pennant Hills, N.S.W. 2120.

UNDERSTANDING AND MANAGING THE ENVIRONMENT

by Ian Douglas
Professor of Geology
University of New England

I am honoured that a geographer should have been asked to give this keynote address, particularly that it should be a geographer from the University of New England, where we are somewhat closer to the natural environment than our colleagues of the big cities. While the current spate of enthusiastic discussion of ecological and environmental problems and, particularly, the occasional piece of action in research, policy formation and education are extremely desirable and praiseworthy, some of us in geography are wondering why all this fuss has suddenly developed. Internationally renowned theoretical physicists and biologists have started to lecture about problems we have been discussing with our first year students for years. Perhaps it is because we have been looking at these real and complex problems for so long that geography is now second only to education as the largest single department of the University of New England (with over 1,100 enrolments).

I am not going to argue who should be leading the development of environmental studies. Disciplinary demarcation disputes are one of the worst aspects of contemporary academic life and secondary education. The entry of such a variety of talent into the study of ecological and environmental problems is most welcome and will probably increase the quality of investigation and teaching about the environment and, more significantly, add weight to the forces attempting to change public and political attitudes to environmental problems. No one discipline can cope adequately with the problems which stem from man's impact on his environment. A continual interchange of ideas is required, but, at the same time, all levels of society must be informed about the need to manage the environment carefully. When members of the general public are questioned about environmental quality and pollution, they reply in

terms of specific problems, such as the disposal industrial waste, Sydney smog, or visible pollution such as detergent foam or oil slicks in creeks and rivers. Even among school children there is little evidence of a general understanding of the linkages, or the flows through, the man-environment system. Everyone ought to have a vision of the environment as a series of ecosystems of differing magnitudes in which organisms tend to evolve a balance with the physical and chemical characteristics of their environment. Every individual action alters one or more of these ecosystems to some degree. The people assembled in this lecture hall are producing an unusually large concentration of carbon dioxide, which poses some environmental problems, coped with by a specially designed ventilating system. Thinking in ecosystem terms leads each individual to appreciate the consequences of his actions and decisions on other components of the ecosystem. Such awareness is essential if better policies of environmental management are to be evolved and put into operation.

This conference has a broad objective to promote environmental studies at all levels of education and, it seems to me, a more specific aim, to set up a series of centres for field studies of particular environments. I doubt whether we all have the same concept of environmental studies. The background notes for the conference indicate a bias towards conservation and the biological sciences, although the previous meetings appear to have had wide ranging discussions. Dr Calder said at the first meeting that environment means all aspects of our surroundings which have an influence on us. Such a definition would mean other people also and would make environmental studies the universal science. Perhaps many people would agree that we wish to advance environmental studies in order to create an awareness and an attitude of mind.

I have entitled this address "Understanding and Managing the Environment" because I believe that while the actual state of natural and man-affected ecosystems, at all scales from a small pond to the world ocean, are being investigated and will eventually be fully comprehended, the application of such scientific knowledge to wisely control and use, or preserve, those ecosystems, may not come about. Today the rate of technological advance is so great that new techniques of both landscape transformation and of landscape restoration and improvement are being developed far faster than their impacts on ecosystems may be assessed. The time lag between technological innovation and the adjustment of environmental management to cope with the side-effects of the innovation is often long. Only in the last two decades has the legacy of nineteenth century industrialisation in Britain begun to be removed. Air pollution of British cities has been reduced by strict controls on the emission of smoke from the burning of fuels which powered the industrial revolution, while the pollution of the River Trent, which draws the English Midlands industrial area, has been held constant, despite a twofold increase in the quantity of waste water discharged into the river.

Distance seems also to affect environmental understanding. The smogs of Los Angeles were well documented long before traffic haze became serious in Sydney. The scientific information was available, the technology was available, but nothing was attempted in the way of forward planning in Sydney to cope for traffic smog, even though it was not too difficult to have the vision to foresee the consequences. Similarly, new towns and planned satellite cities date from before the planning of Canberra, but politicians hail the idea of a planned satellite city near Murray Bridge in South Australia as a great innovation. A sceptic could not be blamed for suggesting that in Australia planning is what governments resort to when things have got in such a mess that there is nothing else they can do. A greater flow of information, not only internationally, but between and within states is required. We must reduce the uncertainty in decision-making on environmental matters.

The Ecosystem Approach

(a) The circulations of energy, water and the chemical elements.

Most processes on the earth's surface are motored by inputs of solar energy. Other energy sources are tidal energy, from the combined potential and kinetic energy of the earth-moon-sun system, and energy from inside the earth, including heat conduction and the convection of energy by the material transport of hot springs, volcanoes and mountain building. The quantities involved in energy exchanges may be measured and an energy budget, or heat budget, calculated for any portion of the earth's surface.

The hydrological cycle, which in its broadest sense of the water budget of the whole earth is a closed system, is usually described in terms of river catchment area open system, bounded by the watershed, subject to inputs from precipitation, by cross watershed transfers, and from the earth's crust below the catchment, and to outputs through the drainage outlet, over the watershed, by deep seepage and back to the atmosphere. Water budget calculations are made for catchments of all sizes, from small agricultural experimental plots to the Amazon river system.

The matter of the earth is not quite constant, with the input of meteoritic dust and extraterrestrial matter, but for most purposes a geochemical cycle (Mason, 1958) can be envisaged, which involves the cooling matter magma, its weathering, release of chemical elements to soils, organic systems, the atmosphere and the hydrosphere, with the eventual redeposition of material to form sedimentary rocks, which in turn may be weathered and broken down again, or may be transformed into metamorphic rocks, and eventually be caught up again in a subcrushed rock melt. The circulation of nutrients between soils, plants, animals and waters is part of this general geochemical cycle. Several nutrient

cycles for natural vegetation have been calculated, and depending on the analytical equipment and sampling methods available, it is theoretically possible to calculate nutrient cycles for any area.

Ecologists and hydrologists have come to realise that the exchanges of energy, water and the chemical elements may be usefully carried out in small experimental catchment areas. Probably the most thorough of such experiments carried out so far is the Hubbard Brook forest study in New Hampshire, U.S.A. (Bormann and Likens, 1969). These experiments provide the energy, water and chemical budgets for specific landscape types, providing the yardstocks against which man's interference with ecosystems may be measured.

(b) Biological approaches to ecosystems.

Ecology has developed largely as a branch of biology, even though human ecology and the ecology of cities have been discussed by geographers and sociologists. The UNESCO Man and the Biosphere Program sees the basic design of the ecosystem as that of a machine capable of intercepting radiant energy from the sun, converting it into chemical energy in such a manner as to ensure the maintenance of its functional structure. Green plants are instrumental in photosynthetics, herbivores and predators contribute to the distribution of energy and matter, and decomposers permit the breakdown of dead organic materials, thus making the mineral elements locked up in organic matter available again to plants. Control mechanisms, often closely related to species diversity, enable ecosystems to maintain, or re-establish if exposed to disturbance, their functional structure.

Biologists see man as part of the ecosystem, modifying it for his own benefit, by transforming the species diversity, for example converting a forest to monoculture, or by altering the inputs of distribution of water, energy or the chemical elements. Completely artificial inputs can be set up, as in the CSIRO phytotron. This approach culminates in ecosystem modelling in which the functioning of an ecosystem is simulated mathematically. To achieve such modelling ecosystem magnitude and boundaries have to be defined. In the case of a river basin or lake, the ecosystem boundaries are relatively easy to define, but many ecosystem boundaries are extremely difficult to define. In his studies of woodland ecosystem Ovington (1962) had to assume that inputs and outputs by animals more or less counterbalanced each other. Transfers across defined ecosystem boundaries emphasise the spatial linkages between ecosystems.

Biologists who have discussed general environmental issues seem to neglect accurate ecosystem definitions and talk simply of such things as "modification of the forest ecosystem" (Ehrlich and Ehrlich, 1970). Such general approaches, while initially arousing interest, are

not effective, as an individual manager will probably assume that the generalisation applies neither to his particular type of forest or his particular locality. The value of the biological approaches to ecosystems lies in the precise documentation of specific types of ecosystem, particularly the many studies prompted by the International Biological Program and the many forest experimental catchment studies such as those at Coweeta in the southeastern United States. Such studies provide detailed case studies the results of which may be applied to similar ecosystems elsewhere.

(c) Natural ecosystems.

Although the monitoring of ecosystems is difficult, particularly complex natural forest ecosystems, the nutrient budgets of many forest ecosystems have been established. Nye and Greenland (1960) and Kenworthy (1971) show that in tropical rainforest the bulk of the nutrient circulation is an internal exchange between the trees and the ground. In Ghana, for example, the bulk of the potassium falling to the ground surface is derived from rain wash from leaves. Of the total addition of 8.82 $m^3/km^2/yr$ of potassium, about 85% is used again in the growth of the forest. This one complex ecosystem with its great diversity of species, great interdependence of life forms and rapid internal turnover of matter has so many lessons to teach all environmental scientists that the preservation of the remaining Australian rainforests ought to be given the highest priority. Even if a single rainforest tree falls down it alters the immediate locality drastically by allowing light to reach the forest floor and a whole variety of light loving species to grow in place of the shade tolerant species normally present on the forest floor. In such instances the linkages between ecosystem components are readily evident. When the understanding of the behaviour of natural ecosystems is available, modification of ecosystems by human activity may be much better appreciated.

(d) Man and ecosystems.

As soon as man begins to alter the forest as in clearing for shifting cultivation, he disturbs the ecosystem. Exposure of the soil creates losses of nutrients through water erosion, burning releases nutrients to the atmosphere and even after abandonment of a clearing the forest is unlikely to regenerate back to the original complex ecosystem, a much smaller diversity of species is likely to occur, with the habitats of many organisms lost forever.

Man's activity can be added into the nutrient budgets of ecosystems. Some are simple additions. For example Ovington (1962) found that trees in a Pinus sylvestris plantation take up an average of 35 kg/ha/yr of potassium, of which 1.78 kg/ha/yr are harvested in logs. Nye and Greenland (1960) indicate the changes to rainforest nutrient cycles as a result of shifting cultivation.

The effects of urban growth can also be monitored. In Britain and the U.S.A. experiments have been running for several years in small river basins in new subdivision areas. By gauging the output from the basin before urban development and then during and after the construction phase, the changes in stability of the ecosystem can be documented. The usual trend is to see a rapid and large increase in the quantity of sediment carried by the stream following the clearning of the land. The sediment load falls as gardens become established, but is likely to remain much higher than before urbanisation. River channels are themselves modified. Because of the higher sediment loads and more rapid runoff from the newly bare soil, river channels change from narrow, deep, winding paths to broad, shallow, straight forms which evacuate higher flood peaks than before. Such changes have serious consequences for people downstream. Here the worst environmental deterioration takes place away from the locality of change. There is a spatial linkage between modification of one ecosystem and the effect on another. Environmental understanding must include these spatial linkages.

Changes to the atmosphere demonstrate these spatial linkages particularly clearly. Smoke and dust are carried away from the emission source and spread elsewhere. Great distances are involved. The Norwegians have found that their lakes are becoming more acid because of SO_2 carried from Britain and Germany and being washed down as extremely dilute sulphuric acid. The recent French nuclear tests and Concorde flight have highlighted other aspects of long range spatial linkages between ecosystems.

Measurement of the effects of human activity will indicate the direction of ecosystem modification, and will provide the basis for the economic and social evaluation of the impact of man on the environment. If a little more of the effort devoted to campaigning for better environmental management was devoted to measurement, the case could be put much more effectively. More important still is a need to centralise available information from all the diverse government and private institutions to get a full picture of what is happening. All too often factors are measured independently by different organisations, without regard for anything more than their own immediate needs. Data on rivers are a good example of this. Fortunately, the INSPECT groups have encouraged the kind of objective approach needed.

Environmental Studies

(a) The need for clarification.

As indicated earlier there is a great need to be more precise about what is meant by environmental studies. To the heating engineer the term can imply air conditioning, to the architect it often means a

blending of building construction and landscape design. This confusion cannot help those seeking to promote environmental education. Environmental studies must imply the study of man's effect on the environment and the effect of the environment on man. They must be based on the ecosystem approach already outlined, but should not be satisfied with a simple analysis of man as a factor in the ecosystem. They should try to look at why ecosystems have been badly managed and how so many environmental problems have arisen. They need to look at human behaviour, at economics and at legal systems. Every aspect of human society affecting management of the landscape needs some attention.

(b) Enquiry in Environmental Studies.

An investigation of environmental problems should include not only the physical dimensions of the problem, but also an analysis of why the problem has arisen. Many natural hazards are environmental problems, yet all too often knowledge of floods, droughts, tropical cyclones and bush fires is imperfect and inadequate. The effects of such events may range from harmless to catastrophic, yet people are often unprepared for catastrophic events. Twice in 1968, in March and October, floods on the Ouse River at York, England, were described in the local press as the worst for 20 years. The record of tropical cyclones along the north Queensland coast is such that events such as the Christmas Day cyclone at Townsville could have been expected at least once each generation. Yet it took people by surprise. More frequent in occurrence are floods on the Hunter and the northern rivers of New South Wales, yet even there, people are not fully prepared for these natural environmental changes. Even more unlikely is an expectation of changes in natural hazard conditions, such as the increased frequency of high floods which result from changes in land use and modification of natural drainage systems. Two great floods have affected the Kuala Lumpur area of Malaysia. The first floods in 1926 were less serious than those in 1971 although they resulted from a greater rainfall. So much disturbance had occurred in the intervening years that much more storm rainfall runs off rapidly to rivers than formerly.

In all these cases, different groups of people have varying degrees of awareness of the natural hazard, its causes and its impact. Burton and Kates (1964) analysed this considerable divergence in perception of environmental hazards by technical-scientific personnel and resource users. Anthropological studies suggest that attitudes may be divided into three categories:

Man subject to Nature (in which we have to accept what comes);

Man with Nature (an ecological type of view that if we work with nature we can survive);

Man against Nature (man will eventually overcome floods and droughts).

Interestingly, a survey in western New Mexico showed that

15 out of 23 Spanish Americans considered man subject to nature;

9 out of 20 Texans considered man to be over nature;

13 out of 22 Navaho Indians considered man to be with nature.

Thus different cultural groups may well have different attitudes to environmental issues and to understand environmental problems, students should look at the attitudes which either create, permit or regulate those problems.

(c) Economics and social psychology.

Even if we recognise variations in environmental value orientations, we must face up to the crucial problems of economic values. The nature of the economic system in Australia and similar countries is such that the use of land and resources is subject to an immense variety of individual economic appraisals and decisions. "An economic system based on private decision making processes leaves much opportunity for environmental decay - not necessarily through conscious efforts of individuals - but through gaps in ownership patterns, lapses in incentives, and uncertainties regarding the future. Correcting these ills will not be easy." (Barkley and Seckler, 1972). To achieve an adequate level of environmental quality, some conventional economic commodities will have to be given up. Public consensus would seem to argue that environmental quality is worth investing in, but is the public prepared to pay for environmental quality, just as electricity, coal or water is paid for? In 1969 a Gallup Poll in the United States of America showed that three-quarters of the population sampled were deeply concerned about the quality of the environment and were willing to pay additional taxes to maintain it. (Eipper, 1970). However, in Australia, Clark (1971) comments: "Quite bluntly the Australian will only assist to pollution control measure if his own pocket remains unscathed ... There is a tendency to look to government, as a matter of right, to bail us out when the going gets tough and to be somewhat petulant when it doesn't come to the party." Such diversity of attitudes to the economics of environmental management requires full attention, for, whatever the technology we possess, polution control will not be introduced until economic and social values are such that the expenditure on controls is demanded.

Social attitudes enter into environmental studies. Anyone familiar with the urban environment will know that as the quality of life in a particular suburb deteriorates, those who can afford to do so move out, and those unable to afford rent in better areas move in. Environmental quality is something the rich campaign for and enjoy. The whole

of society does not necessarily benefit from an improvement. If anti-pollution laws become so stringent, firms may be unwilling or unable to meet the extra costs involved, and may close factories, or move elsewhere, causing local unemployment. In Australia there is a possibility that there will be a trade-off between states, with firms moving to the state where it is cheapest to pollute. Even within a state, firms may find rural shires willing to tolerate far higher waste emission rates than would be tolerated in the metropolitan area. Broken Hill Company Proprietary Company Limited announced earlier this year that, after spending $20 million on pollution control at one of their Newcastle works, the requirement of a further $5 million expenditure on pollution control made the future operation of the plant doubtful. This threat to jobs is a direct response to improved environmental quality, although probably also affected by economic conditions in the steel industry.

Boulding (1971) notes that one of the most difficult problems of environmental control is its impact on the distribution of income and wealth. "Much of the pressure on the environment today arises because the poor, as a result of economic development, are now enjoying things which used to be the privilege of the rich, such as travel, increased protein diets and high consumption of power. Solutions to environmental problems frequently involve repressing or confining the activities of the poor, while leaving the rich much as they were." (Boulding, 1971, p. 368). Furthermore, public spending on environmental quality means a use of resources which may have been employed in health, education, overseas aid or parliamentary salaries.

The economic implications of environmental management affect society in differing ways. No clear cut economic analysis is possible, but the study of the environment ought to embrace the economic factors of environmental management. Environmental studies thus need to go beyond the understanding of men and the ecosystem to include consideration of how environmental policies should be determined, how they operate in practice and why there are difficulties in getting people to agree on policies which affect their own surroundings and their own pockets.

Attitudes and decision making

(a) Perception of the environment.

Some of the behavioural aspects of environmental management have already been considered. Individuals see different environments and respond to different criteria. There is a real geographical environment, within which is a behavioural environment. Sonnenfeld (1972) defines the behavioural environment as one of a vested set of environments each of which is differently inducive of elements important for man. The broadest level is the geographical environment, constituting both

proximal and distal elements of man's universe. This is reduced in stages to the operating environment, which is that environment impinging on man within which in some way or other he is likely to be involved; to the perceptual environment which is that environment of which man is aware; and finally to the behavioural environment, the environment which elicits a behavioural response from the individual. In environmental management, decision making may be examined in terms of theoretical and practical ranges of choice in any given situation. Objectively, if the environment is fully understood and all the available means of improving environmental quality are known, a theoretical range of choice may be established. However, the manager, unaware of some of the alternative treatments, unable to consider some alternatives because of institutional or legal constraints, sees a narrow, practical range of choice. The actual selection within the perceived range of choice depends on the way in which a manager analyses the different elements of the decision. (White, 1961). Such analyses are not straight forward, but full of personal experience, inhibitions and emotions.

(b) Individual responsibilities.

Environmental quality decisions all involve spatial linkages which render unilateral decisions to improve standards somewhat limited in effect. Individual landowners are able to improve conditions on their own properties, but despite their investments on improvements may be invaded by pests, weeds or polluted air and water from a neighbouring property. The individual firm may wish to have its workers living in a clean and pleasant community, but may be unwilling to install anti-pollution devices due to pressure from a board of directors to produce goods at minimum cost. Thus the individual factory manager may suffer from a conflict between his duty to the community in which he lives and his duty to the stockholders of his company. He will have to choose between local unpopularity and losing his job.

Individual managers thus find environmental quality problems difficult to resolve. Without guidelines proposed by governments, managers will tend to give environmental quality considerations a very low priority in their decision making. All resource management and environmental quality decisions must be basically public decisions and cannot be made unilaterally by any particular interest group, be it industrialist, agricultural or conservationist. If the freedom to choose the kind of environment in which people want to live is to be preserved, the freedom of choosing to destroy the environment must be curbed. In turn, every choice brings benefits only at the expense of certain (often unanticipated) costs. It takes a great deal of thought and foresight to know whether as a whole and in the long run the benefits of any particular choice outweigh the costs.

(c) Corporate attitudes.

Managers in decision making terms imply everyone from the individual householder or landholder to the directors of international companies. The latter show varied responses to the movement towards stricter pollution controls. The trade-off internationally by which companies can shift production or products to localities with less stringent controls is an example of poor corporate attitudes. Yet at the same time many companies and organisations exert sound environmental management programs.

Differing corporate attitudes to environmental management are shown by the way upland reservoirs for urban water supplies are controlled in Britain. Sheffield Corporation encouraged afforestation around its reservoirs, but the Lower Clyde Water Board (formerly Glasgow Corporation) does not favour an extension of the forested area, because of the disturbance and erosion hazard during the planting period and the difficulties of controlling disturbance by contractors' workers during the logging stage. Around Loch Katrine, from which Glasgow's water is drawn, sheep farming is carried out by the water authority and controlled tourist movement (by paddle steamer) is permitted on the Loch (Douglas and Crabb, 1972). New reservoirs in Britain have to be planned to allow for recreational activities.

(d) Government attitudes.

Governments, at all levels, local, state and national, exhibit a wide range of attitudes towards environmental problems. In Sydney, local governments have been elected on an environmental quality ticket, but in country areas, where unemployment is high and rural indebtedness great, environmental issues would arouse little interest. Even in a city like Armidale it requires great public pressure to ensure that bad planning decisions are not made. In local government the onus is on the public to prove that a development will detract from environmental quality, rather than for the developer to prove the desirability and necessity for his development, which is probably how it ought to be.

State and national governments have ministries where policies are made without regard to the activities of other ministries. While a government may pay lip service to environmental issues, the setting up of environmental management agencies is only good if such agencies are given teeth and power. Above all governments have to look at legislation.

The type of change in policy that can occur through a change in Ministerial personnel is illustrated in Hancock's account (1972) of the role of Mr T. Lewis (then Minister of Lands) in the operation of the Kosciusko National Park. Continual pressure and influence on governments is required to make them ever aware of environmental issues. The main

hope that I have is that through education we will obtain both electors and representatives with an appreciation and understanding of environmental studies.

Environmental Education

The role of environmental education is internationally recognised as indicated by one of seven objectives of the UNESCO Man and the Bioshpere Program, which is:

"To promote environmental education in its broadest sense by:

(a) developing background material, including books and teaching aids, for educational curricula at all levels;

(b) promoting specialist training in appropriate disciplines;

(c) stressing the interdisciplinary nature of environmental problems;

(d) stimulating global awareness of environmental problems through public and other information media;

(e) promoting the idea of man's personal fulfilment in partnership with nature, and his responsibility for nature."

Any local, state or national program of, or movement for, environmental education ought to liaise with the appropriate National Committee for the Man and the Biosphere Program. Sadly, those in the frontline of contact with scholars seldom hear of the work being done in the higher levels of scientific administration. I doubt if many people at this meeting know what Australia is doing for the Man and the Biosphere Program. However, ultimately the future of the human race depends on successful management of the global environment and we should therefore try to see that environmental education retains a global as well as local and national viewpoint.

REFERENCES:

Barkley, P.W. and Seckler, D.W. (1972) Economic Growth and Environmental Decay: The Solution becomes the Problem. New York: Harcourt Brace Jovanovich, 194 pp.

Bormann, E.H. and Likens, G.E. (1969) The watershed-ecosystem concept and studies of nutrient cycles. In Dyne, G.M. van, editor, The Ecosystem concept in natural resource management. New York and London: Academic Press, 49-76.

Boulding, KE. (1971) Environment and Economics. In Murdoch, W.W., editor, Environment, Resources, Pollution and Society, Stamford, Connecticut: Sinauer Associates, 359-367.

Burton, I. and Kates, R.W. (1964) The perception of natural hazards in resource management. Natural Resources Journal, 3, 412-441.

Clark, S.D. (1971) Notes of introduction to discussion of paper "Administrative and Legal Aspects of Saline Water Use and Management". Paper presented at the Australian Academy of Science Symposium on Salinity and Water Use, 13 pp. mimeo.

Douglas, I. and Crabb, P. (1972) Conservation of Water Resources and Management of Catchment Areas in Upland Britain. Biological Conservation, 4, 109-116.

Ehrlich, P.R. and Ehrlich, A.H. (1970) Population Resources Environment. San Francisco: Freeman, 383 pp.

Eipper, A.W. (1970) Pollution Problems, Resource Policy, and the Scientist. Science, 169, 11-15.

Hancock, W.K. (1972) Discovering Monaro: a study of man's impact on his environment. Cambridge University Press, 209 pp.

Kenworthy, J.B. (1971) Water and nutrient cycling in a tropical rain forest. University of Hull, Department of Geography, Miscellaneous Series, 11, 49-59.

Mason, B.J. (1958) Principles of Geochemistry. New York: Wiley, 310 pp.

Nye, P.H. and Greenland, D.J. (1960) The soil under shifting cultivation. Technical Communication Commonwealth Bureau of Soils, 51, 51 pp.

Ovington, J.D. (1962) Quantitative ecology and the woodland ecosystem concept. Advances in ecological research, 1, 92-103.

Sonnenfeld, J. (1972) Geography, Perception and the behavioural Environment. In English, P.W. and Mayfield, R.C. (editors), Man, Space and Environment, 244-251.

White, G.F. (1961) The choice of use in resource management. Natural Resources Journal, 1, 23-40.

THE ECOLOGY CRISIS AND SOCIETY
Can Education Help Us Survive

by
Stephen G. Hill
School of Sociology
University of New South Wales

1. Allan Ginsberg: "Sunflower Sutra"

I walked on the banks of the tincan banana dock and sat down under the huge shade of a Southern Pacific locomotive to look at the sunset over the box house hills and cry.

Jack Kerouac sat beside me on a busted rusty iron pole, companion, we thought the same thoughts of the soul, bleak and blue and sad-eyed, surrounded by the gnarled steel roots of trees of machinery.

The oily water on the river mirrored the red sky, sun sank on top of final Frisco peaks, no fish in that stream, no hermit in those mounts, just ourselves rheumy-eyed and hungover like old bums on the riverbank, tired and wily.

Look at the Sunflower, he said, there was a dead gray shadow against the sky, big as a man, sitting dry on top of a pile of ancient sawdust -

I rushed up enchanted - it was my first sunflower, memories of Blake - my visions - Harlem and Hells of the Eastern rivers, bridges clanking Joes Greasy Sandwiches, dead baby carriages, black treadless tires forgotten and unretreaded, the poem of the riverbank, condoms and pots, steel knives, nothing stainless, only the dank muck and the razor sharp artifacts passing into the past -

and the gray Sunflower poised against the sunset, crackly bleak and dusty with the smut and smog and smoke of olden locomotives in its eye -

corolla of bleary spikes pushed down and broken like a battered crown, seeds fallen out of its face, soon-to-be-toothless mouth of sunny air, sunrays obliterated on its hairy head like a dried wire spiderweb,

leaves stuck out like arms out of the stem, gestures from the sawdust root, broke pieces of plaster fallen out of the black twigs, a dead fly in its ear,

Unholy battered old thing you were, my sunflower O my soul, I loved you then!

The grime was no man's grime but death and human locomotives,

all that dress of dust, that veil of darkened railroad skin, that smog of cheek, that eyelid of black mistry, that sooty hand or phallus or protuberance of artificial worse-than-dirt - industrial - modern - all that civilisation spotting your crazy golden crown -

and those bleak thoughts of death and dusty loveless eyes and ends and withered roots below, in the home-pile of sand and sawdust, rubber dollar bills, skin of machinery, and the guts and innards of the weeping coughing car, the empty lonely tincans with their rusty tongues alack, what more could I name, the smoked ashes of some cock cigar, the cunts of wheelbarrows and the milky breasts of cars, wornout asses out of chairs and sphincters of dynamos - all these

entangled in your mummied roots - and you there standing before me in the sunset, all your glory in your form!

A perfect beauty of a sunflower! a perfect excellent lovely sunflower existence! a sweet natural eye to the new hip moon, woke up alive and excited grasping in the sunset shadow sunrise golden monthly breeze!

How many flies buzzed round you innocent of your grime, while you cursed the heavens of the railroad and your flower soul?

Poor dead flower? when did you forget you were a flower? when did you look at your skin and decide you were an impotent dirty old locomotive? the ghost of a locomotive? the specter and shade of a once powerful mad American locomotive?

You were never no locomotive, Sunflower, you were a sunflower!

And you locomotive, you are a locomotive, forget me not!

So I grabbed up the skeleton thick sunflower and stuck it at my side like a scepter,

and deliver my sermon to my soul, and Jack's soul too, and anyone who'll listen,

- We're not our skin of grime, we're not our dread bleak dusty imageless locomotive, we're all beautiful golden sunflowers inside, we're blessed by our own seed and golden hairy naked accomplishment-bodies growing into mad black formal sunflowers in the sunset, spied on by our eyes under the shadow of the mad locomotive riverbank sunset Frisco hilly tincan evening sitdown vision.

2. Is this the world which we have created in the name of affluence and progress? Are we caught within that world in the skin of the technological body we have created with equal technical skill to Mr Frankenstein? Have we become "the ghost of a locomotive" called progress? - our very understanding of what and who we are being a product and reflection of a social/economic system that technology has necessitated and that is accelerating us into irreversible environmental disaster.

If the quick answer is "yes", then the change required to reverse progress into environmental disaster is nothing short of a complete transformation of ourselves and the ethos of our society.

In this talk, what I intend to do is to approach these questions to see what consequences for environmental education they suggest. Though time is short I will look at some of the effects of man's exploitation of his environment - on himself, on society; I will look particularly at our potential for change and the role of education.

AN ENVIRONMENTAL CRISIS - MYTH OR REALITY?

To demonstrate man's effect on the environment requires simply opening your eyes, trying to hear (or avoid hearing), and breathing. But the significance of a deterioration in our physical environment and "quality" of life is rather more invisible and pervasive and imminent than our immediate experience can tell us. The arguments about the deterioration of our physical environment must at least be familiar to you, through, for example, Paul Ehrlich and Rachel Carson. So, to establish the existence of a problem to this audience - who are, I suspect, the "converted" anyway - is hardly necessary. Suffice, then, to indicate the larger terrain by way of a few summary comments drawn together into a framework suggested by Douglas Brooks, President of the Travellers Research Centre in Connecticut, United States of America. Brooks, writing in the journal, Bioscience, in 1967, saw that there are five key areas of environment decay:(2)

1. Impoverishment of our resources:

essential resources - food, water, living space. For example, New Zealand.

desirable resources - wildlife, play space, walking space.

2. Increasing level of pollution, noise and ugliness within which we are being immersed.

3. Over-population, crowding, congestion and hence conflict over incompatible uses of the environment. For example, on competition between man and his car:

   (a) automobiles occupy more space in America than do people (Edward Crafts, Bureau of Outdoor Recreation);

   (b) four-lane expressways use 50 acres of land per mile, preferably the most level and strategically located land;

   (c) eighty-two percent of Los Angeles consists of space allocated for the moving or parking of automobiles;

   (d) Sydney is following the same path - it has been estimated that by the year 2000, 4-6 million people will live in Sydney with 2-5 million cars between them.

4. Increasing depersonalisation or "thingification" of life, due to growth in size, complexity and ubiquity of cities, traffic and mass communications media.

5. Environmental decay - of "potentially Wagnerian proportions" where inadvertent and perhaps irreversible modifications of the earth's weather and climate by man could render all other kinds of decay trivial by comparison - for example, purposeful manipulation of climate: very recently it was admitted in the United States of America that scientists have been experimenting in the transformation of climate over Indo-China - in support of the use of American war technology against the North Vietnamese.

Our effect on the environment in each of these areas is also of geometric rather than arithmetic proportions. As one example, Gordon Harrison, Program Officer for the Ford Foundation[3] reports a conversation he had with a pest control officer in Borneo: "He told me that some

years ago the World Health Organisation launched a mosquito control program in Borneo and sprayed large quantities of DDT, which had proved to be very effective in controlling the mosquito. But, shortly thereafter, the roofs of the natives' houses began to fall because they were being eaten by caterpillars, which, because of their particular habits, had not absorbed very much of the DDT themselves. A certain predatory wasp, however, which had been keeping the caterpillars under control, had been killed off in large numbers by the DDT. But the story does not end there, because they brought the spraying indoors to control houseflies. Up to that time, the control of houseflies was largely the job of a little lizard, the gecko, that inhabits houses. Well, the geckos continued their job of eating flies, now heavily dosed with DDT, and the geckos began to die. Then the geckos were eaten by the house cats. The poor house cats at the end of this food chain had concentrated this material, and they began to die. And they died in such numbers that rats began to invade the houses and consume the food. But, more important, the rats were potential plague carriers. This situation became so alarming that they finally resorted to parachuting fresh cats into Borneo to try to restore the balance of populations that the people, trigger-happy with the spray guns, had destroyed."

THE SOCIAL EFFECTS OF ENVIRONMENTAL DECAY

Man cannot be removed from a relationship to his environment - he is part of an ecological system. Man must exploit his environment; he must deliberately unbalance the system to produce a surplus crop. But man has learnt to control and manipulate his environment, and in doing so has fallen further and further out of a natural equilibrium. This action has been reinforced by the development of very efficient ways of learning of the environment - science and the rational scientific method. And science has been guided by the principle of the "control of nature", a phrase, Rachel Carson(4) emphasises, that was "conceived in arrogance, born of the Neanderthal age of biology and philosophy, when it was supposed that nature exists for the convenience of man".

The Urban Environment Where We Live

The effect of this disequilibrium on our "quality of life" is striking. On the one hand it has clearly led us into affluence as well as effluence. But we are being isolated more and more from nature - for example, in the food chain by the increasing proportion of our diet taken up by instant processed, artificially coloured flavoured products; in our living environment by isolating ourselves in concrete and in artificial air conditioning.

We are, as Karl Marx points out, alienated, estranged, held separate from nature, and as with Rousseau who sees nature to be the

essence of our being, we become estranged from ourselves, we compartmentalise our lives into meaningless sectors, we live out our lives in environments we do not consider ideal, because we see no alternative to living within our particular urban system.

The urban system is also not a socially neutral physical environment, in terms of its effect and reflection in human values and behaviour. For example, Young and Willmott[5] showed a change in the values of ex-ghetto residents from Bethnal Green after exposure to Greenleigh, a low density suburban tract of London. First, the setting led to each family "keeping up with the Joneses"; a certain amount of money became a prerequisite so the men started to emphasise their jobs more. People began to value other people less as a basis for behaviour and started to value "things". This process of depersonalisation meant the people became object-oriented in the low density setting, though they had previously been person-oriented.

Secondly, they developed a future time orientation - unless they planned ahead, for going shopping, catching public transport to work - they could not accumulate the objects that had become important for them to possess. In Bethnal Green they used to be able to make spontaneous decisions on the use of time, but this was not feasible where great amounts of space had to be considered. Because of a changed physical environment, life became more structured, planned, object centred and depersonalised.

Also, the urban setting requires certain usage of space. As I have mentioned before, we tend to use up the majority of space in cities for automobiles - which, by the way, like serpents snaking through our homes, are the major cause of death and disablement among people aged between 18 and 25[6]. But with overpopulation, we are then crowding more and more people into the limited amount of space left - into "little boxes - all made out of ticky tacky - which all look just the same". We can reflect on the effect of cramping people into spaces that are too small, from an experiment conducted on rats by Calhoun[7]. Calhoun put 80 rats in high densities in four pens located in a row and connected by ramps. There were two major environmental effects operating. The first was the high density, which affected all the pens. However, the position of the ramps made the nature of the two middle pens different from the two end pens; that the two latter pens had only one ramp instead of two connecting them to other pens allowed a more strict system of social control inside them.

Each of these environments led to distinctive distortions of the prevailing pattern of rat activity. The end pens were characterised by the dominance of a single male and homosexuality among most of the other males who remained. The middle pens featured a high rate of infant neglect and mortality, a constant turnover of leadership accompanied by

violence, and the occurrence of pansexuality among males.

So we create our "insulated" environment on the basis of our values, and our physical environment determines our values, our life style, our social behaviour. Our physical environment is essentially determined by what we require for our economic condition and for us to demonstrate our social differentiation. The effect of overcrowding, of health and life hazards, of removal from closer relationship with nature reflects back into ourselves, and the social tensions, conflicts and meaninglessness with which we are faced. Allan Ginsberg's poem reflects this condition: he implores - "Poor dead flower? when did you forget you were a flower? when did you look at your skin and decide you were an impotent dirty locomotive? the ghost of a locomotive?" If we are continuously immersed in ugliness our standards of comparison become based in ugliness: if we are continually battered by noise, unpleasant or obnoxious fumes, cluttered and badly used space, our mind too becomes cluttered, our social relations reflect our tensions.

Let us explore this idea that our consciousness - or, as Reich(8) defines it, the "total configuration ... which makes up (the individual's) whole perception of reality, his whole world view", his filter to guide both perception of the world and social behaviour - is determined by our relationship to our physical environment; and, in traditional Marxian mode of analysis, that we mould our physical environment to fit our economic necessity. There are two important consequences:

Consequence One: Detrimental changes in our physical and ecological environment will affect our whole perception of reality and the form of our social relationships. Two scenarios of the future reflect something of the social changes which might be predicted from a rapid environmental decay.

A scenario of the future presented by Henry Mayer(9) reflects something of the social changes which might be predicted from a rapid environmental decay. Mayer, in criticising Paul Ehrlich's simplistic approach to the social action required to avert the environment crisis, writes:

> "First, we shall see an increasing scrabble for differential control of resources. The top resource grabbers are likely to be the industrial nations and, within those nations, the very people who are on top now or else some new elites.
>
> Second, the world's top dogs will have to "justify" themselves. A new, and profoundly anti-egalitarian ideology and perhaps religion will arise to do that job. Whether it is racism or some other superior versus inferior division which will form its content is not very important.

Third, the resource grabbers will give "the enemy", that is the rest of the world's population which will want its share of what there is, a name, a face, and an image.

Fourth, there will be a complete reversal in our attitudes to war and to health measures: nuclear war will be praised and practiced - given the alternative that all will die versus that of "only" some hundreds of millions dying. Nuclear war will no longer be the ultimate horror. There won't even be a pretence, as there is still today, that we "all" care about some millions of refugees slowly dying somewhere far away - from the angle of the resource-monopolisers it will be a jolly good thing. Efforts to cut down infant mortality in poor nations will cease.

Fifth, those who have and will try to hold will turn into fortress countries, desperately attempting to isolate themselves from the rest of the world. Yet, after a while, it is likely that they will try to turn other countries into resource suppliers by coercion. The worst forms of past colonialism will seem mild in relation to what is to come.

Spaceship Earth -

Within nations, those groups which are willing to promise the longest and most lasting monopoly to a given country and act with the greatest ruthlessness toward others are likely to get control."

If the ecological catastrophy advances unhindered, the effect on society is likely to be equally as disastrous, not only in terms of social disruption and conflict, but also in constraining man's ability to respond with the massive social action required to ensure survival of the species.

Consequence Two: Here we come to the second consequence of the notion that consciousness is determined by our economic/social/physical environment. The values of society from within which we currently can view the ecological crisis are values which have evolved in support of the very socio-economic system which has allowed us to create the crisis. These are values that emphasise "mastery of nature", objective rationality in analysing problems (and hence, as Herbert Marcuse points out, a philosophy which must support the status quo, because the radical empiricism of modern scientific thought allows us to think only in terms of what exists; it provides no way of analysing what does not exist, that is, alternative social systems and alternative futures). Our economic necessity requires an "obsolescence", changing modern, progress-oriented socio-economic structure. For example, a speech by Harlow Curtice, President of General

Motors in 1956 demonstrates the ethos of contemporaneity[10]:

> "Continuing emphasis on change, on a better method and a better product, in other words, on progress in technology, has been the major force responsible for the growth and development of our country. Some call this typical American progress "dynamic obsolescence" because it calls for replacing the old with something new and better. From this process of accelerating obsolescence by technological progress flow the benefits we all share - more and better job opportunities, and advancing standard of living - the entire forward march of civilisation on the material side ...
>
> The promotion of the progress of science and the useful arts is of crucial importance ... (but) there is a far more vital consideration. I refer to the importance of technological progress in assuring the continuance not only of American leadership in the free world, but of the democratic processes themselves."

As far as being <u>able</u> to respond to the ecological crisis, our society is caught in the double bind of a "Catch-22": we <u>must</u> respond or our society and our economic viability will be destroyed, but we cannot respond because our world now is set within the framework of a system which is creating the need to change, creating the pollution, requiring population increase. The ability to respond requires a massive transformation of societies' values and hence its order of social, economic and political priorities.

<u>The Transformation: the role of education</u>.

The crux of what I have been saying is that really serious environmental decay can only be averted by a large scale transformation of society and its values. The consequences for "environmental education" are profound. The communication of information to the general public about the environment and their effect on it approaches this transformation at such a superficial level that it will be rendered effectively useless. I am not really convinced this profound level of transformation can occur. The only precedents from the past are religious messiahnic movements. Education does, however, have to take a role in this change. So, accepting for purposes of this analysis the continuance of our present economic and political systems, I would see education to play a role in social transformation at three levels:

<u>Level One</u>: The most fundamental level; education is needed to help us understand ourselves in society, to enable us to question our own values and see the influence of our socialisation, our physical, economic and social environments on our "consciousness", our world view - on our

acceptance of what is "natural" and "unquestioned" in our society. A fundamental transformation of values is based on this perspective, a world view Reich calls "Consciousness III" where "the individual frees himself from automatic acceptance of the imperatives of society and the false consciousness which society imposes".(11)

Level Two: The second but fundamental level of education requires a change in the teaching of science and eventually in the acceptance by the general public of an underlying philosophy of science. Professor R.O. Slatyer(12) suggests this change... "from an attitude to our environment which regards it as a resource to be exploited for short-term personal, regional or national gain, to an attitude of living ecologically in a way that is essentially conservative of the environment. Man the technologist must therefore become man the ecologist ... to live in harmony rather than oppose, the natural workings of the biosphere." But this change is so fundamental to our way of life that it must be predicted in education at Level One, that is, based on a questioning of the values of society and of science within that society; a questioning of values we have come to accept with the same reverence as natural laws. The second level education change also requires a transformation of the way science is taught and scientific research is practised at every level in formal schooling.

Level Three: The third level of education needs to be concerned with disseminating a wider and deeper understanding of technical facts and questions about the environment and man's relation to it. Raising the technical literacy of the community about the environment is important for three reasons:

First, to demystify the problems, the solutions proposed, governmental and industrial action taken to avert ecological crisis. While technical thought and action lie behind a veil of ignorance from the general public, the public remains powerless: they will feel that problems can be solved and somehow the government or the industrialists - who effectively do control their environment - will work out a solution. Such a sense of powerlessness acts as a shield. It prevents the general public being caught up in the societal transformation that has to occur - they will continue to rely on traditional other authorities to cure any problems for them.

Secondly, to structure political action. If ecological issues are understood by the general public and by politicians, then, with impending crisis, they become political issues - issues where politicians cannot mislead or misrepresent. If politicians have a technical understanding of ecological issues, then they are more capable of evaluating alternative courses of legislative and political action.

Thirdly, to provide the basis for personal action - not just

at the superficial level of using white rather than coloured toilet paper but within one's work role, within one's general use of the environment as a source of leisure and relaxation. This must eventually lead to change in attitudes towards type and level of consumption.

But we must not make the mistake of believing that attempting to raise the technical literacy of the community is enough. This educational step is useless unless it is accompanied by the educational philosophies of Levels One and Two. Our society must first realise that

> "We're not our skin of grime, we're not our dread bleak dusty imageless locomotive, we're all beautiful golden sunflowers inside, we're blessed by our own seed and golden hairy naked accomplishment-bodies growing into mad black formal sunflowers in the sunset."

REFERENCES:

(1) Allan Ginsberg, "Sunflower Sutra".

(2) Douglas L. Brooks, "Environmental Quality Control", Bioscience (1967), 874-877.

(3) Gordon Harrison, Report of a Press Conference, in Paul B. Weisz, "The Contemporary Scene", McGraw Hill, 1970, p.293.

(4) Rachel Carson, "The Silent Spring", London: Hamilton, 1963.

(5) Michael Young and Peter Willmott, "Family and Kinship in East London" London: Routledge and Kegan Paul, 1957.

(6) Sol Encel, "Planning for Man's Survival", RMIT Midday Lectures, 10 August 1972.

(7) John B. Calhoun, "Population Density and Social Pathology" in Leonard Duhl (ed.) "The Urban Condition", New York: Basic Books, 1963, pp.33-43.

(8) Charles A. Reich, "The Greening of America", Penguin, 1971, p.20.

(9) Henry Mayer, "The Logic of Zero Population Growth", The Australian, Thursday, 9 September, 1971.

(10) Harlow Curtice, quoted in Jules Henry, "Culture Against Man", London: Social Science Paperbacks, 1966, pp.22-23.

(11) Charles A. Reich, op. cit., p.90.

(12) R.O. Slatyer, "Human Ecology - What Does it Mean?" Australian Natural History, 16 (1970), p.395.

TEACHING SCIENCE FOR AN UNDERSTANDING OF OUR TOTAL ENVIRONMENT AND THE NEED FOR CONSERVATION

by
D.F. McMichael
Formerly Director, National Parks & Wildlife Service, N.S.W.
and
A. Strom
Advisor in Conservation, N.S.W. Department of Education

INTRODUCTION

(a) Population Growth and the Use of Resources

The world's population is growing in number at an increasingly fast rate. The estimated figures for total human population at various dates between 1875 and the present time, together with projections of population increase in the future, calculated on the basis of current trends and all available data, show that the rate of growth has been increasing rapidly during the last century and overall will continue to increase geometrically. The result is that there is increasing demand for the natural resources which are the basis of our existence. This increasing demand is compounded by technological innovation and the generally rising standards of living, which means that the rate of which we are using the world's resources is now at a very high level and can be expected to increase. Careful investigations of the availability of resources suggest that the world will be able to meet this demand provided that technical skills are fully utilised and that international economic and trading relationships are allowed to function freely. However, continued population growth at anything like the present levels would eventually lead to an impossible situation, where demand would outstrip availability of resources, leading to a levelling off or reduction of population by extrinsic or intrinsic factors. Various authors have predicted that unless population increase is slowed down and eventually halted by birth control on a world scale, famine, disease, natural catastrophe or war will inevitably produce the same result. Providing population growth is halted quickly enough, the world's resources should prove adequate to maintain human life at standards comparable with those now enjoyed by the advanced countries. But even before this stage can be

reached, serious population declines as a result of famine and disease are likely in the less advanced (underdeveloped) countries as numbers outstrip resource availability, because of the time lag which is inevitably associated with the transformation of an economy from an agrarian to an industrial base. Clearly this problem of population size and resource availability is one of the major problems to be faced by this and future generations.

(b) The Ecology of Human Populations

Man is an animal, and like all animals, lives in association with other animals and plants, and in a physical environment determined by geological and climatic factors. In order to understand what man's relationship is to the world in which he does, and must always, live, we must study his ecology. This will provide the basic knowledge by which we may be able to cope with the problem of ensuring that our resources are managed in such a way as will enable us to survive as a species. There are many data now available from ecological studies of organisms other than man, which can serve as the basis for an investigation of human ecology - since in general it is not possible to manipulate human populations in experimental situations which would allow the derivation of necessary data to predict what will happen to human populations under environmental stress.

The sort of information required includes demographic data (birth rates, death rates, age frequency distribution, fecundity, etc.), the effects of limitation or modification of resources on these parameters, and the biological significance for man of other organisms (including other species of plants and animals, and of other humans).

(c) Science - the Key to Understanding our Environment

Man's environment is amenable to scientific study, and indeed, only science can provide the basis for understanding the nature of man's environment. Science teachers carry a heavy responsibility to future generations to see that through their teaching they give to all their pupils a full and realistic appreciation of man's total environment, in order that (1) the decisions made by the next generation concerning the handling of the world's resources will be informed ones, and (2) there will be a more widespread understanding of the need to limit population size and to more strictly control our interference with and handling of environmental factors.

Although the prospect of strict control over environmental modification by man may seem objectionable to some in a free enterprise society, there is no doubt that we should no longer permit individuals, by thoughtlessness or carelessness, to continue to wreak the havoc which has occurred in the past. Such matters as soil erosion, air and water

pollution, mismanagement of good productive land, unnecessary destruction of natural environments and wildlife are matters of fundamental concern to all of mankind and will be increasingly more so in the near future.

It is the challenge of this generation to ensure that the next generation has a more responsible attitude to the total environment than we have shown.

(d) The Need for Conservation to Maintain the Quality of our Environment

Conservation has been defined in many ways, but perhaps the simplest is "the wise use of resources". The words "wisdom", "use" and "resources" imply a fundamental scientific understanding of both the nature of the resources and their interactions with each other, and the predictable effects of any manipulations of them which we may choose to make.

A broader approach to conservation introduces an important new consideration for man - that is, the aspect of quality of environment, especially in relation to aesthetic considerations. Such matters as well planned uncrowded cities with plenty of open space which enable people to live in them without suffering the frustrations of so many city dwellers today; well planned and integrated transportation systems which allow rapid and comfortable movement of people without danger, delay or defacement of natural beauty; a countryside free from unnecessary noise and ugliness, the latter including such things as roadside advertising hoardings, badly located power transmission lines, litter, and the scars of mining operations; and unpolluted air, streams and coastlines where human beings can breathe freely, swim without concern, and enjoy an abundance of fish and wildlife.

Most of these things are not essential to survival, but they certainly are important to the satisfaction of very real human needs and undoubtedly affect the mental and physical health of the community. As such they too are part of our total environmental resources, and we can use them wisely or unwisely.

While not so directly the concern of science they have scientific aspects which can be dealt with as part of science teaching; for example, the effects of air and water pollution on wildlife; techniques for air and water purification; the effects of overcrowding on animal behaviour; the biological basis of restoration of mined areas; and the geographic basis of urban and transportation planning.

COMPONENTS OF MAN'S ENVIRONMENT

A detailed analysis of the factors making up the human environment is beyond the scope of this work. However, the following suggestions are made as to topics which should be included in a science course in

High Schools, and the ways in which they can be dealt with as part of an overall conservation approach.

(a) Land

Land is the basic natural resource, because its extent is for practical purposes finite, reclamation being of very minor significance. Almost all conflicts in resource use hinge on the availability of land. This conflict arises largely because we still think in terms of single purpose use of land, whereas there are many compatible uses, which can be made simultaneously of much of the land (for example, the use of some forest and water catchment land for grazing). We also need to give more thought to the ways in which we use land for particular purposes in order that it might be used most effectively. Technological advances also require flexibility in the evaluation of land for particular purposes, and the economic system should be geared to allow such flexibility. A proper economic and scientific analysis of existing land use patterns should be the basis for assessment of any planned development, and due weight should be given to the recreational and wildlife value of land in its natural state, which too often is looked upon as having no value, other than for development, for example, the clearing of natural forests for softwood plantations should be assessed against the acquisition of marginally productive agriculture land for this purpose.

(b) Water

The hydrologic cycle is the basis of the water resource. In the use of this resource full consideration should be given to the effects of interference with various parts of the cycle. The water resource is like land - for practical purposes of finite extent at the present time. The only possibility of increasing the total amount of water on a regional basis lies in the modification of climate (by artificial seeding of rain clouds) and the desalination of sea and other saline waters. Meanwhile we are dependent upon the natural recycling of water by evaporation from the sea and conservation of the water resource depends on our ability to use it to the maximum extent at the various stages in the cycle without impairing its quality. This means the application of science and technology to such features as maximum retention of water in soil and catchments, with controlled run-off at desirable rates. Once water has run off into streams and rivers, we have to use it to the best advantage. This involves such considerations as water storage and the problem of reducing water loss by evaporation from stored surfaces; re-utilisation of water for many purposes during its passage to the sea; and the related problem of maintaining water quality, especially the control of pollution and siltation so that a usage at one point in the river system will not affect its suitability for use lower down. In some situations it may be necessary to purify the water for further use or to recycle water of low quality for industrial purposes, and finally to control the quality of water discharging into the sea, especially in estuaries where certain

impurities may directly affect marine productivity, human health and the aesthetic quality of coastal water which is important for recreational use.

(c) Air

Air is a mixture of gases which is believed to have reached its present composition over the millions of years during which the earth has formed and life has evolved. The particular balance of oxygen and carbon dioxide is believed to be directly related to the plant cover of the earth's surface, which has produced the present oxygen level by photosynthetic transformation and maintains the O_2/CO_2 balance by fixation of atmospheric CO_2. Intuitively we would assume that air was a virtually inexhaustible resource which would always be available in sufficient quantity to support all life without any problems. However, man has begun to have two serious effects on air which are directly related to his numbers and use of resources. The most widespread effect, if proven, is the slow change in CO_2/O_2 balance which is thought to be resulting from (a) the enormous quantities of CO_2 released into the atmosphere by industrial processes, and (b) the clearing of large amounts of vegetation, especially forests, which reduces the capacity of the earth's plant life to reduce the CO_2 and maintain the O_2 level. Such changes may eventually have an effect on climate, and on ultraviolet light penetration of the atmosphere with consequent effects on living organisms. It is possible that such long-term effects will be coped with by the evolutionary process of adaptation, but there may be undesirable consequences of which we are yet unaware.

The second, less widespread, but more serious short-term effect is the pollution of the air in urban and industrial regions through the disposal of wastes from combustion. Almost all cities today suffer to some extent from polluted air, the primary causes being exhaust products from automobiles, smoke from domestic fires, and industrial emissions of various kinds. The control of air pollution is directly related to the chemistry of combustion and can be achieved by scientific techniques of smoke abatement or prohibitions on certain types of fuel. The effect of pollution is increased by the special climate of the city, which differs from its immediate rural surroundings. Such things as pavements, buildings and methods of disposing of rainwater actually change the local climate.

(d) Plants

The surface of the earth is dominated by plant life, the greater part of which has been modified or affected by man's activities. Man has directly transformed whole communities by his cultivation of plants for particular purposes (for example, pasture grasses, cereal and other crops, various trees for fruit production and for lumber and paper manufacture).

In addition, his use of land for other purposes, especially grazing and logging, has led to changes in the structure of the plant communities occurring naturally on the land. He has also cleared land of its plant life for urban, industrial and transportation purposes. Since all animal life depends fundamentally on the plant life of the particular community in which it lives, these changes have had equally profound effects on animals. Man has not only interfered directly with plant life, but through the side effects of other activities, especially his use of fire, the drainage of wetlands and control of river flooding, has had indirect effects on the ecology of plants.

In many cases these changes have led to unsatisfactory results. There are numerous examples where the replacement of the original plant cover by crops has been a failure due to lack of scientific knowledge of the ecology of the crop in question or of the ecology of the community which has been modified (for example, emergence of serious pest species, both plant and animal). An understanding of plant ecology, succession and the structure of plant communities is necessary to allow us to properly manipulate the plant life of the earth for our maximum benefit and to avoid and correct the mistakes of the past.

In contrast to these modification, man also uses certain plant communities in their natural state, especially as national parks and nature reserves for recreation and the conservation of wildlife, and for water catchment protection. For the former it is generally regarded as desirable to maintain natural conditions (though there can be national park and nature conservation values in modified plant communities), while most drinking-water catchments are maintained with strictly natural plant communities in order to protect water quality.

(e) Animals

Man's relationships with the animals in his environment have been complex. He has hunted them for food, hides, hair and for sport; domesticated them for work, food and companionship; destroyed them as pests; admired them for their beauty; worshipped them as sacred objects; distributed some species widely; and they include the only natural enemies whom he fears. Consequently his effect on animals has been profound, and, as mentioned above, his manipulation of plant communities and water systems has had extreme repercussions on animal species quite unintentionally.

We are less dependent on animals for food than we are on plants, but they play an increasingly important part in feeding the world's population, and the distribution of selected somestic species will increase. The ecological impact of domestic and other animals introduced into new environments has been great, both through direct interference with native animals (predation, competition) and through the effect on vegetation.

The mass eradication of pests, especially insects, is a new feature of man's relationship with the animals in his environments. The widespread use of pesticides has markedly increased crop production, but has had spillover effects to other forms of wildlife and into the marine environment, where it can be assumed virtually all animals now carry a load of pesticide residuals. The correct handling of hunted animal species is a lesson which can be taught by numerous examples of over exploitation ranging from the American Bison to Whales.

The animals in our environment include other human beings. Man's whole history is one which has been significantly affected by his relationship with other communities and races, most of which have no parallel in the biology of other animals. Such aspects as war, slavery, trade and commerce, altruism, are all unique to man, the social animal. In recent years biologists have been paying increasing attention to the biological effects of society itself, especially of city life. Here studies of other animals can be used in the interpretation of observed human effects (such as the psychological and biological effects of overcrowding and pollution).

In understanding his relationships with other animals including other humans, we have much to learn from zoological science, especially from population and community ecology, and behavioural science. Our successful management of the animal components of our environment depend on this understanding and because of the social implications, the result could be crucial for the survival of civilised life as we know it. Conservation of the animals used for food and pleasure is a simple matter for which virtually all the basic data are available. Conservation of other environmental components affected by our use or handling of animals is sometimes more complex but is completely amenable to scientific study for solution. But the conservation of environmental quality within human communities is largely a sociological problem to which science must pay increasing attention.

(f) Soils

The quality and distribution of soil is fundamental to man's use of the land for agricultural purposes. Soil is a complex material, which forms slowly by the breakdown of parent rock through chemical and biological processes. Soil can be used wisely, in such a way as to maintain its quality and prevent its loss by erosion, and any deterioration of quality or quantity can be rectified in time by appropriate techniques which result in soil formation or restoration. Soil chemistry and soil biology, especially the renewal and cycling of nutrients are critical to understanding the proper use of soil. Soil erosion as an outcome of poor land management is an aspect of ecology which requires strong emphasis.

(g) Minerals

All the resources considered so far are those which are renewable or reusable and can be maintained at their present level, or improved by careful management without loss or deterioration in quality. They thus offer hope to mankind in his attempt to maintain the quantity and quality of human life. Minerals are a different kind of resource - non-renewable.

The diversity of man's mineral requirements has increased with technological advance. Each year sees new extractive techniques yielding useful minerals. On purely rational grounds, bearing in mind their non-renewable nature and our increasing demands, it would seem prudent to assess carefully the available resources and ration their use. However, experience has shown that in every case, the mineral resources of the world are either available in such quantity as to permit virtually unlimited exploitation or else improved technology has made lower grade ores acceptable. Projections for world demand to the year 2000 indicate no scarcity of any important mineral. The only exceptions seem to be the fossil fuels which are dealt with below under Energy Sources.

At the same time, the wasteful manner in which we use some minerals at present (for example, steel) is to be deplored on economic grounds and emphasis should be placed on the need to reuse scrap metals. The side effects of mineral use (mining scars, destruction of other valuable resources including natural landscapes and communities, for example, heavy mineral sand mining; and the littering of the landscape with discarded junk) are aspects of mineral resource use which should be corrected.

A conservationist approach to these problems would emphasise the value to the community of landscape and natural beauty, which should not be lost for the sake of the cash value of the underlying mineral resources unless it can be shown to be essential in the national interest.

(h) Energy Sources

The basis of all life is energy, which derives fundamentally from only two sources - the sun and radioactivity. However, the former is available to man in three forms -

(1) as direct solar radiation which provides the energy for plant growth and which is virtually unlimited;

(2) as energy available from "fossil" fuels, originally transformed into organic matter through photosynthesis, and now available for release from mineral fuels such as coal, oil and gas; and

(3) as kinetic energy stored in tidal movements, wind and precipitated rainfall.

Radioactive energy sources are rapidly assuming importance on a world scale and as a result of the development of breeder reactors and with the possibility of "fusion" power reactors, this energy source seems to be virtually limitless. However, the consumption of conventional fuels has risen rapidly in recent years, and consideration should be given to whether we are using these resources wisely. Despite the predicted limits of available fossil fuels it is difficult to foresee any need to curb their use. Man has increasingly demonstrated his ability to find alternative power sources (for example, the replacement of wood and animal oil by mineral fuels and more latterly the development of radioactivity as a source of power). Recent interest in further power sources such as tidal movements, and direct solar energy conversion devices indicates that man will not find available energy a limiting resource in the foreseeable future.

Again it is the impact of present energy utilisation on the environment which needs control. The impact of coal mining is in no way different from other extractive industries on natural landscape, while the transformation of coal, gas and oil to usable energy is a major source of air and water pollution. The polluting effect of oil is a serious problem in the marine environment and will become increasingly more so as offshore oilfields are developed and larger ships are used for its transport. The radioactive pollution of the environment is yet another problem deriving in the main from energy transformation.

An "energy" source which is used increasingly is hydroelectric power, in which the kinetic energy of water falling from one level to another is used. This energy ultimately derives from solar radiation, through evaporation and air movement. Hydroelectric power generation also has an impact on man's environment by altering the natural water regimen of river systems and through the construction of dams and ancillary works. There are many classic examples of the disregard of natural values by hydroelectric power construction authorities (for example, the threatened flooding of the Grand Canyon of Arizona by plans to dam the Colorado River) and again emphasis should be placed on the loss of environmental quality by such actions.

(i) Climate

Climate as a component of man's environment is as yet not a resource which man uses (except broadly speaking insofar as he enjoys particular climates for recreational purposes). Nonetheless with the possibility of techniques for ameliorating climate (for example, by increasing rainfall through cloud seeding) and with the known local climatic alterations which occur in city environments, man needs to be increasingly aware of the possible side effects of climatic alteration on the "quality" of his environment.

(j) Space

Until recently man had not entered space and undoubtedly it is not a limited resource. Nonetheless in the few short years of space exploration we have commenced the pollution of space with derelict rockets and satellites, and no doubt eventually the pollution of other planets with man made objects will occur. This may not have any important consequences, but there is also the possibility that man will pollute other planets with organisms (such as bacteria) from earth, which on scientific grounds is highly undesirable.

CULTURAL COMPONENTS

(a) Society

As mentioned above under "Animals", society is an aspect of man's total environment which can have profound effects on him. For most of the world's population, the quality of living is determined by the society in which one finds oneself, and there are marked contrasts between life in big cities and that in smaller rural communities. Geography teachers have a special responsibility to analyse the effects of man's social existence on his behaviour and mental health, and to indicate the planning factors which are necessary for urban environmental quality to be upgraded. It must be borne in mind that during the next thirty-odd years, with world population expected to double, new cities and towns at least equal to what already exists will be required, apart from urban renewal of older cities. This presents an unrivalled opportunity for improvement, and some interesting speculations have been made regarding future societies which are worthy of study, such as that by Nigel Calder in his book "The Environment Game".

(b) Beauty and Ugliness

These environmental factors have already been stressed in dealing with modification of natural landscapes by resource use. They are equally an aspect of the cultural components, for example, architecture and town planning, and contribute greatly to environmental quality.

(c) Heritage

Used in the historical sense "heritage" is an important cultural component of environment, which can provide "quality" through an awareness of the past as a guide to things of lasting value, especially art and architecture, music, law and ethics, and national identity.

(d) Freedom and Responsibility

Political freedom and responsibility are conceptual aspects of man's environment, closely linked with society and heritage, which are

"resources" to be carefully safeguarded against loss or misuse.

(e) Economic Systems

Although varying economic systems prevail throughout the world, they are important in man's environment, for they are basic to the availability of resources and their utilisation by the community. With the predicted increase in world population and demand for resources, economic co-operation will be vital to our attempts to provide adequately and equably. Indeed many commentators have stressed that unless the nations of the world are able to work in close economic co-operation, especially as regards trade, tariffs, and the availability of economic assistance to underdeveloped countries, then man will not be able to surmount the coming crisis.

THE INTEGRATION OF ENVIRONMENTAL SCIENCE AND CONSERVATION WITH THE CURRICULUM

The teaching of science must have as its end-product, not a set of known facts in a variety of individual sub-disciplines such as chemistry, physics, geology, biology and some aspects of geography, but rather a wide range of concepts applied to life-situations, one such life-situation, and a vital one too, being conservation - the use of the natural resources on a sustained-yield basis.

At all levels in the school system, concepts are more convincingly presented by reference to natural areas and life situations; generalisations to the national or global scale should then be more credible.

If science is taught as an interpretation of environment, then it centres on the study of natural phenomena and the usage of the concepts of the various scientific disciplines to elucidate the pattern in nature.

The effect of modern culture upon environment and consequently upon man, should have constant reference in the various scientific studies. The subject material will then be presented in relationship to the impact upon man and his use of the resources. Chemistry seeks to explain the atomic nature of matter in relation to organic and inorganic processes affecting man; physics has a world of machines and forces, and the nuclear behaviour of elementary particles to relate to life-situations; geology shows how natural materials and natural forces shape and produce environment; biology discusses the reaction to, and dependence of, living material in environment; and geography studies the way in which man reacts and uses his culture in facing environment and climate.

The relating of the various scientific sub-disciplines to man and his environment is not a direct attempt at integration of subject

material within the sub-disciplines themselves. There is still an opportunity for movement for those who would teach by giving experience and inducing the underlying facts, or those who would teach by presenting the underlying facts first and then deducing the observational consequences. It is probably true that science teaching should consist of a combination of the two processes, and this would provide the means of relating the studies to actual reference in life-situations.

If science teaching is seen by teachers as a conscious effort to explain environment or the phenomena of environment, it should be possible to build up a chain of concepts that are essentially the basis of environmental science. It is not easy to relate how a basic relationship to environmental science can provide the sense of individual involvement and responsibility to the resources of environment and consequently a conviction about the essential totality of conservation, even in one's own experiences; yet this seems to be the valuable chain of events. Perhaps the truth lies in frequent association with natural environments and inspiring field situations wherein there was a sufficiency of emotionalism and aesthetic satisfaction to provide the driving force of fully satisfied concepts.

Ecology as an Integrating Study

A study of an ecosystem is a means of inter-relating the sub-disciplines of science, since it can refer the attention to the chemical properties of soil derived from the elements contained in rocks or influenced by the growth and decay of various organisms; to the physical forces of erosion or aggregation and consolidation, and the simple laws of gravity and equilibrium; and to the structure of organisms and their interdependence and adaptability.

It is only a small step from the "dynamic equilibrium" of the ecosystem to the chaotic condition of imbalance characteristic of the catastrophes frequently initiated by man in natural environment. This is the opportunity to point up the salient principle of conservation - skill in management of the particular ecosystem which man has determined is necessary and acceptable, so that changes do not run riot and out of control.

There is a pattern of management within all ecosystems, within all environments, which is self-imposed and which is the solution to an equation involving the geography and geology of the situation, the chemistry and physics of soil and atmosphere, and the response of life in the circumstances. This solution has often been called "the balance of nature", but we know it to be not so much a balance as a dynamic equilibrium.

The same basic factors apply to the specialised environments created by man as to the pristine environments of nature. Studies of

pristine environments, agricultural ecosystems or the highly artificial domestic domain of man, all provide an opportunity to analyse the flow of transmuted solar energy.through a pattern of usage, and the inevitable conclusion that slight deficiencies or amendments in the ecology at earlier levels may and do have catastrophic effects at the top, particularly where man is concerned.

Since it is the interplay of organisms under a set of conditions specified by climate, soil and the chemistry and physics of living and non-living material which produces environment, ecology provides a central role for not only integrating the sub-disciplines of science but also for substantiating the absolute importance of conservation.

It is possible to identify within various subjects of the High School curriculum a number of topics relevant to the teaching of conservation. Few school systems have been able to introduce "Conservation" as a separate subject in its own right. An alternative is to analyse the available courses of study, recognising topics which can be taught to develop understanding of conservation. For example, from physics, the conservation of energy; from biology, population ecology; from geology, soil formation and erosion; from geography, the influence of resources on man's social organisation; and from history, how mismanagement of land can affect human affairs.

A list of topics from these subjects could be prepared as a separate course of study which could be taught in its own right. Alternatively, such a list could assist teachers in finding opportunities to teach conservation throughout the individual subjects. Such a list is given as an appendix to this chapter.

Teaching Environmental Science and Conservation

The approach to environmental science should be through experience in a wide range of field studies of the environments themselves before any analyses of their constituents are made. The feeling of communities and identification with homesites are initial qualities for realisation. The question might then be raised as to what constitutes the dominant requirements of a homesite and how homesites vary from one another. This approach commences with the organisms in environment and suggests that the analysis then begins to probe the rocks and the climate as producers of landforms and soil, followed by generalisations on the chemical and physical influences as demonstrated in the life-forms and their response to the environment.

A wide variety of field situations not immediately familiar to the student will obviously present a valuable picture of complexity: this statement assumes contact with both natural and man-made environments under study conditions so that careful consideration will afford an impact upon the viewer.

From the very first meaningful experience with environment, the student should be encouraged to consider the conservation of the situation.in which he finds himself, basing his considerations upon -

firstly, a concept of planned usage of the resources provided by nature and necessary to optimum human welfare and enjoyment of living; and

secondly, a management activity which aims to guarantee availability in perpetuity of the resources, or where this is not possible, availability for as long a period as is absolutely possible.

Field studies in biology and geology and the use of museums and zoos in these disciplines are well established. These excursions can be specially developed to teach the principles of conservation.

Field Studies and Class Evaluation

The following pattern of approach towards the study of environment is suggested as a suitable technique based on the initial analysis of the rocks and landforms. Obviously, one should exploit the local scene to begin with; considerations of conservation should fit into the analysis rather than arise from separate discussions.

1. The fundamental geological features of the scene: the nature of the rocks, the processes which have initiated local landforms, the dependence of the landforms upon the rocks, and soils upon the rocks: the geological pattern behind local scenery and how this influenced the nature of the organisms.

2. The qualities of the soils and how this has affected local land use: the chemical and physical constituents of the soil and the reaction of nature and man in using or rejecting these constituents; problems in handling the soils or water supplies; absence or availability of minerals; man's attempts at using the environments for living, industrialisation, forestry, fisheries or maintenance of naturalness.

3. The organisms in the scene: the characteristics of native and introduced plants and animals and the status of each, firstly, in their associations into communities, and secondly, in their assessments as a contribution to man's existence.

4. Visiting areas where resources are being used, managed or abused: discussions with managers and making critiques of management success or otherwise; what effect is use of the resource having upon the resource itself? What entities are entering the environment from without and polluting or generally pushing "the

dynamic equilibrium" in an irreversible direction away from survival of the resources? What are the chemical, physical and biological principles operating or being replaced? What are the problems of management and how could improvements be effected?

5. Generalisations to state, national or global situations: an effort to extend student experience through travel to an ever-widening contact with environments always with the analytical approach - this could be on school excursions, on extra-curricula activities with clubs, parents or officially organised tours; use of colour slides, photographs, movie film, publications and speakers to demonstrate the need to expand experience at first hand; using the situations presented by these experiences to discuss the involvement of the various sub-disciplines of science; assessing the problems of management of the resources in the situations; consideration of management success and measures for improvement.

6. The difficulties imposed by current legislation and accepted administration: what is the legislation and administration for the resource management? Have they been successful? Do they show congnisance of the scientific principles affecting resource management? If not, in what particulars do they fail and why? What amendments are needed and how should they be applied? What can we learn from elsewhere and what errors should we avoid from other experiences?

The Relationship of Conservation Education to Environmental Studies

The difference between the conservationist and the exploiter rests largely in the attitude of the former to ensure continuing availability of the resource being exploited for an immeasurable period of time. Both appreciate the benefits to be had from using the resource.

A training in how to study environment and a knowledge of the scientific phenomena of environment, does not, of course, infer that the student becomes a convinced conservationist.

It has already been postulated that the first essential in teaching conservation seems to be the need for student experience at first hand, with the resource to be conserved and with the advantages of planned use of the resource. Experiencing the advantages of planned use can be either positive or negative - if positive, then there should be a felt satisfaction, and if negative, a felt loss because of inferior, or the absence of, planned use. If the student does experience an emotional satisfaction about the value of a resource, there is then an opportunity to fix a concept of its place in dignified living.

Some thought must be given to ways of evaluating the various management techniques in use, or possible, to ensure that the concept of value in dignified living may be secured for all time. Each resource might be taken in turn and a study made of it in terms of the following categories -

Availability - how available is it? What problems are there in determining availability? Do we know how to overcome these problems?

Quality - is the resource still available in its original quality? Can the quality be maintained and how? What factors have, or are likely to, pauperise the resource? What can be done to offset pauperisation?

Human Welfare - what contribution does the resource make to human welfare, or conversely, what would dignified living lose if the resource were all used up or significantly degraded?

Enjoyment of the Resource - what programs can be undertaken to give the student enjoyment of the resource (preferably with emotional overtones), including essentially, field experiences and sightings of optimum values in use?

Optimum Usage - can the best usages of the resources be experienced and evaluated? Can students participate in these usages?

Management Procedures - can various management procedures be observed and evaluated? Can students become intimately involved in these procedures?

The Resource Itself - what can be learnt as a body of knowledge, about the characteristics and nature of the resource itself? What is the interplay between a given resource and all others, either as individual resources or as companions in an environment?

In summary, it would appear that the fundamental guidelines in teaching conservation involves at least these five factors -

1. A wide spectrum approach to conservation and an effort to impress upon students that there is a single natural resource complex which should not be considered as several

independent and immutable fragments. An understanding of the scientific basis to environment construction and operation is essential.

2. Encouragement of personal student enjoyment or experience with the resource so that there is an emotional and personal identification in the effort to secure abundance and availability; conversely a sense of great personal loss arising from probable extinguishment, squandering, inappropriate use, or inefficient management.

3. Field experience with the resource and with the management of the resource, laying full stress upon becoming a fund of knowledge about the resource and its management. By helping management in some way, the vulnerability of the resource and the problems of management may be better understood.

4. Students should make a personal evaluation of their experiences with the resource and its management and subject their thinking to the controversial opinion of their peers.

5. The whole exercise must conclude by a critical assessment of current legislation for conservation and of current practices for the use and management of the resource.

Aids to Environmental Studies

Field Studies

There are significant advantages in locating and establishing a series of field studies sites which may be managed substantially as reference areas for many of the aspects of environmental studies. These sites might cover reference opportunities for water and soil conservation projects, land development for agriculture, urban environments and other similar land usages, as well as sites for plant and animal communities.

Conservation authorities have a grave responsibility to strongly publicise the value of their functions, to awaken a public sonscience to the responsibility of the present generation, and to demonstrate the manner in which the resource provides for the "good life" for all men.

The conservation authorities for soil, water, forests, fisheries, wildlife and natural environment do provide information, etc., and there is a need for more integration.

Field studies sites should commence with the school natural area. In each school, an area should be reserved as a nature corner and this should serve as an outdoor laboratory. In designing new schools an area

of at least one acre should be set apart for this purpose. Steps should be taken to establish such areas in schools already cleared.

District field studies sites would provide facility for several schools to undertake studies not possible or better demonstrated, than in the school natural area. An inventory of such sites, particularly outlining the usefulness of them and the problems of usage, should be undertaken. For each site, details of the values for environmental and conservation studies should be listed, together with guide material for teachers and students. The district site would include locations on a variety of projects besides reserves for the preservation of plants and animal communities, such as forests, soil and water undertakings, and places demonstrating man-made environments. Where possible these district field studies sites would have field laboratories to be used conjointly with the fieldwork in progress at the site.

Field studies centres are required at strategic locations where a district of special interest or several features are available and should be used by visitors from far afield and/or over several days. These involve the provision of accommodation either directly at the centre or by some arrangement close by. Field studies centres provide a means of introducing students to a wide variety of environments, land usage practices and conservation techniques not otherwise available. Special facilities by way of laboratories, libraries, classrooms and some specially trained staff could make the work of these centres highly efficient and most profitable. The Field Studies Council of Great Britain has a network of such centres.

Audio-Visual Aids

Earlier mention has been made of supplementing the limited time which is available for school or college excursions, by the use of slides, films and talks about environments and management schemes not visited. In addition, audio-visual aids are most valuable for securing the best results from field experiences. The best approach to the use of field studies sites is through small group or individual projects. To do this, the student must be equipped with printed and illustrative material which will provide for activities, sketching, note-taking and follow-up, either in the field laboratory or back at the school or college. Very great assistance will be afforded by viewing slides or films, or listening to recorded instructions or information about specific sites, prior to or as follow-up from the excursion.

Extra-Curricula Activities

A little extra time may be secured by encouraging extra-curricula activities by students through visits to sites during free time or through the activities of various outdoor clubs.

Educational institutions such as Museums, Zoological Gardens and Botanical Gardens have already provided an important supplementation to compensate for the difficulty in providing students with a wealth of field experiences. Dioramas and habitat groups in museums are extremely useful, whilst special displays or groupings of animals and plants in zoos and gardens provide similar assistance. It is most encouraging to have these institutions looking for ways and means of expanding contact with the structural units of natural environments, whilst recently there have been moves for at least one of these agencies to provide authoritative assistance in the study of whole environments, in situ.

Teacher Education in Environmental Studies

The basis for teacher education must follow the same essential procedures of personal contact with environment, its complexity and variability.

Courses for teachers in environmental studies must be heavily loaded with fieldwork to show the way to study in the field, to familiarise teachers with the constituents of environment and to introduce them to sites and locations valuable to teaching. This fieldwork should be an informal and enthusiastic approach to naturalness and management projects, preferably with small groups so that discussion and debate can be frequent and thought provoking. The fieldwork may arise from within or without the school, the former probably providing a wide canvas approach to fieldwork in general, the latter offering encouragement to undertake fieldwork at a specific site or to experiment with advice from a person more experienced in a given area of knowledge of the field. On the other hand, teachers should avoid becoming persuaded to approach field studies from the attitude of a specialist in some particular aspect of natural history, such as botany, ornithology or geology. Another common error is to see conservation as nature conservation or to adopt a perfectionist approach to the preservation of natural values.

A clear understanding of environment and conservation arises from a nice balance between a general education involving the several subdisciplines of science, and a long and frequent contact with the environment and conservation projects. It is the task of formal courses to provide the scientific qualities and introduce the field studies. Teachers must expand on the latter through the use of organisations interested in field studies and conservation, and authorities charged with the task of managing resources. It is mutually beneficial to work with the conservation societies since they are responsible for a public voice in conservation and at the same time provide a forum for membership discussion and a means of getting into the field. Conservation authorities have yet to provide the services to education which is so necessary but undoubtedly repeated requests for the service of background information and fieldwork encouragement must finally produce a satisfactory response.